Colicins as antibiotic alternatives for the treatment and prevention of post-weaning diarrhea and edema disease in swine

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A.S. Leaflet R2025

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Summary and Implications

It is estimated that over 50% of all economic losses in weaned pigs are due to *Escherichia coli* infections, causing either diarrhea or edema disease. Despite animal health and economic concerns, concerns over the spread of antibiotic resistance will limit the types of antibiotics that can be used in production animals. Therefore, we have examined alternatives to conventional antibiotics.

Introduction

With increasing concern over the spread of antimicrobial resistance, it is expected that antibiotic use in animal feed will become more highly regulated (FDA Guidance #78, 1999; #152, 2002), and costly. This has spurred research towards finding alternatives to conventional antibiotics for use in the animal feed industry. To this end, a great deal of research has been conducted on bacteriocins, bacterially-derived proteins with antimicrobial activity. We have examined colicins, a class of bacteriocins produced by, and effective against *E. coli* and closely related members of the family *Enterobacteriaceae*, as potential alternatives to conventional antibiotics in animal feed. Colicins have been shown effective against Gram-negative bacteria, such as *E. coli* and *Salmonella* strains (Guterman et al., 1975; Stroud et al., 1998), but have not been evaluated for efficacy against *E. coli* strains responsible for post-weaning diarrhea and edema disease. In this study, colicins A, E1, and N were selected to provide representation of different methods of membrane recognition and integration seen among the pore-forming colicins (Pugsley, 1987). These proteins were expressed by *E. coli* and purified by ion exchange chromatography. Their efficacy against *E. coli* strains responsible for post-weaning diarrhea and edema disease (F4 and F18) was determined.

Results and Discussion

Colicins E1 and N were effective in inhibiting the growth of *E. coli* F4 and F18, whereas Colicin A was not. A dose of 50 μg Colicin E1/mL was needed to inhibit all growth of F4 for 6 hours. A significant reduction in the growth of F18 was seen with as little as .25 μg Colicin E1/mL of culture, and a complete inhibition of growth for 6 hours was seen with 1 μg/mL of culture. Colicin N was effective in inhibiting the growth of *E. coli* F4 (K88) and F18 at doses of 1 and 10 μg/mL of culture, respectively. To completely inhibit the growth of both F4 and F18 for 6 hours required 25 μg of Colicin N/mL of F4 (K88) and 50 μg/mL of F18.

Although colicins have great potential as an alternative to conventional antibiotics in feed, it would not be cost effective to purify this protein from naturally occurring colicin producing *E. coli* strains, or to include the levels of these bacteria necessary to obtain an antimicrobial effect in the feed. We are currently examining the use of biotechnology to produce these proteins in a more cost-effective manner.

Acknowledgements

This research was funded in part by BRDC.